5.2.10 HEALTH AND SAFETY

This section presents potential health and safety impacts to INEEL workers and the offsite public from implementing the waste processing alternatives described in Chapter 3. The estimates of health impacts are based on projected radioactive and nonradioactive releases to the environment and radiation exposure to facility workers. As discussed in Section 5.2.7, releases to surface water would be minimal and would not be expected to result in adverse health impacts. This section also summarizes worker illness, injury, and fatality incidence rates based on historical INEEL occupational safety data.

Because one of the alternatives (Minimum INEEL Processing) would involve shipment of mixed HLW to the Hanford Site for processing, this section briefly describes potential health and safety impacts to workers and the offsite public from treating INEEL waste at the Hanford Site. A more detailed discussion of health and safety impacts from treating INEEL waste at the Hanford Site is presented in Appendix C.8.

5.2.10.1 Methodology

DOE used data on airborne emissions of radioactive materials (Section 5.2.6) to calculate radiation dose to the noninvolved worker and maximally exposed offsite individual and the collective dose to the population residing within 50 miles of INTEC. The radiation dose values for the various alternatives were then multiplied by the dose-to-risk conversion factors, which are based on the 1993 *Limitations of Exposure to Ionizing Radiation* (NCRP 1993). DOE has adopted these risk factors of 0.0005 and 0.0004 latent cancer fatality (LCF) for each person-rem of radiation exposure to the general public and worker population, respectively, for doses less than 20 rem. The factor for the population is slightly higher due to the presence of infants and children who are more sensitive to radiation than the adult worker population.

DOE used radiation dose information provided in the project data sheets (see Appendix C.6) for projects comprising each option to estimate the potential health effects to involved workers (i.e., workers performing construction and operations under each alternative) from construction and operations activities. Radiation dose was calculated as annual average and total campaign dose summed for the projects to estimate health effects by option.

For nonradiological health impacts from atmospheric releases, DOE used toxic air pollutant emissions data for each project under an alternative to estimate air concentrations at the INEEL site boundary. For the evaluation of occupational health effects, the modeled chemical concentration was compared with the applicable occupational standard which provides levels at which no adverse effects are expected, yielding a hazard quotient. The hazard quotient is a ratio between the calculated concentration in air and the applicable standard. For noncarcinogenic toxic air pollutants, if the hazard quotient is less than 1, then no adverse health effects would be expected. If the hazard quotient is greater than 1, additional investigation would be warranted. For carcinogenic toxic air pollutants, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen.

5.2.10.2 Radiological and Nonradiological Construction Impacts

Under all alternatives there would be some amount of radiation exposure to construction workers. Construction workers involved in upgrade and expansion of HLW facilities would be exposed to low levels of radioactive contamination. For more information on specific projects for each alternative, see Appendix C.6.

Table 5.2-18 provides summaries of the number of involved workers, annual average collective dose, total collective dose, and estimated increase in number of LCFs for the total construction phase for each alternative. Most of the waste processing alternatives result in similar levels of total collective worker dose ranging from 72 to 120 person-rem. The highest collective dose of 120 person-rem occurs under Full Separations Option, Planning Basis Option, Transuranic Separations Options, and Minimum INEEL Processing Alternative. The corresponding increase in number of latent cancer fatalities for any of these options would be 0.05.

Nonradiological emissions associated with construction activities would result primarily from the disturbance of land, which generates fugitive dust, and from the combustion of fossil fuels in construction equipment. As stated in Section 5.2.6, dust generation would be mitigated by the application of water, use of soil additives, and possibly administrative controls. Emissions of criteria pollutants from construction equipment may also cause localized impacts to air quality. Construction-related impacts to workers from criteria pollutant emissions are expected to fall within applicable standards (see Section 5.2.6).

5.2.10.3 Radiological and Nonradiological Operational Impacts

Radiological Air Emissions - As stated in Section 5.2.6, Air Resources, waste processing and related activities at INTEC would result in releases of radionuclides to the atmosphere. No future discharge of radioactive liquid effluents that would result in offsite radiation doses would occur under any of the alternatives (see Section 5.2.7). Therefore, DOE only calculated potential health effects from airborne releases of radioactivity.

Table 5.2-19 provides summaries of radiation doses and health impacts from atmospheric emissions from the waste processing options. Health effects are presented for (a) the maximally exposed individual at an offsite location; (b) noninvolved onsite workers at the INEEL areas of highest predicted radioactivity level; and (c) the offsite population (adjusted for future growth) within a 50-mile radius of the INTEC. The annual doses represent the maximum value predicted over any one year the waste processing occurs. Doses over periods which involve only interim storage of waste would be much less. The annual average project doses were multiplied by the project duration and summed for all projects within a given option to determine the integrated dose and resultant health effects for each option. Modeling indicated that the dose due to ground contamination did not contribute significantly to the total dose for the primary nuclides and pathways of concern.

In all cases for air emissions, the dose to the maximally exposed offsite individual is a small fraction of that received from natural background sources and is well below the EPA airborne emissions dose limit of 10 millirem per year (40 CFR 61.92). The highest annual dose of 0.0018 millirem to the maximally-exposed offsite individual would occur from the Planning Basis and Hot Isostatic Pressed Waste Options. This estimated annual maximally exposed offsite individual dose is slightly higher than the estimated doses for the Continued Current

Table 5.2-18. Estimated radiological impacts to involved workers by alternative during construction activities.

			Separations Alternative			Non-Separations Alternative			Minimum INEEL Processing Alternative	
Receptor	No Action Alternative	Continued Current Operations Alternative	Full Separations Option	Planning Basis Option	Transuranic Separations Option	Hot Isostatic Pressed Waste Option	Direct Cement Option	Early Vitrification Option	At INEEL	At Hanford[a]
Annual average number of involved workers	21	21	96	96	96	90	90	90	96	NA[b]
Annual average collective dose (person-rem)[c]	15	15	24	24	24	23	23	23	24	NA[b]
Total construction phase worker dose (person-rem)[d]	72	72	120	120	120	110	110	110	120	NA[b]
Total increase in number of latent cancer fatalities	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	NA[b]

a. Construction activities associated with this alternative would consist of building three canister storage buildings and a calcine dissolution facility. As shown in Appendix C.8, Sections C.8.5.1 and C.8.5.2, there would be no radiological dose associated with construction of these facilities.
b. NA = Not applicable
c. Doses are average values over any single year during which construction occurs.
d. Total construction phase dose is based on the average annual dose for each project that comprises each alternative multiplied by the duration for each project and then summed for each alternative.

Table 5.2-19. Estimated public and occupational radiological impacts from atmospheric emissions.

			Separations Alternative			Non-Separations Alternative			Minimum INEEL Processing Alternative	
Receptor	No Action Alternative	Continued Current Operations Alternative	Full Separations Option	Planning Basis Option	Transuranic Separations Option	Hot Isostatic Pressed Waste Option	Direct Cement Waste Option	Early Vitrification Option	At INEEL	At Hanford[a]
Maximally exposed offsite individual dose (millirem/year)[b]	6.0×10^{-4}	1.7×10^{-3}	1.2×10^{-4}	1.8×10^{-3}	6.0×10^{-5}	1.8×10^{-3}	1.7×10^{-3}	8.9×10^{-4}	9.5×10^{-4}	2.8×10^{-5}
Integrated maximally exposed offsite individual dose (millirem)[c]	0.022	0.019	2.5×10^{-3}	6.3×10^{-3}	1.3×10^{-3}	0.021	0.019	0.031	0.024	5.0×10^{-5}
Estimated probability of latent cancer fatality for the maximally exposed offsite individual	1.0×10^{-8}	1.0×10^{-8}	1.2×10^{-9}	3.2×10^{-9}	6.5×10^{-10}	1.0×10^{-8}	1.0×10^{-8}	1.5×10^{-8}	1.0×10^{-8}	2.5×10^{-11}
Noninvolved worker dose (millirem/year)[d]	7.0×10^{-6}	1.8×10^{-5}	4.4×10^{-5}	9.0×10^{-5}	3.4×10^{-5}	3.6×10^{-5}	3.0×10^{-5}	4.8×10^{-5}	1.0×10^{-4}	1.3×10^{-5}
Integrated noninvolved worker dose (millirem)[c]	2.5×10^{-4}	2.0×10^{-4}	9.2×10^{-4}	8.6×10^{-4}	7.1×10^{-4}	5.8×10^{-4}	3.6×10^{-4}	1.3×10^{-3}	1.4×10^{-3}	2.3×10^{-5}
Estimated probability of latent cancer fatality for the noninvolved worker	1.0×10^{-10}	3.6×10^{-8}	2.2×10^{-9}	4.0×10^{-8}	1.2×10^{-9}	4.0×10^{-8}	4.0×10^{-8}	2.0×10^{-8}	2.0×10^{-8}	5.2×10^{-10}
Dose to population within 50 miles of INTEC (person-rem per year)[e]	0.032	0.094	5.6×10^{-3}	0.095	3.1×10^{-3}	0.097	0.095	0.048	0.048	1.3×10^{-3}[(f)]
Integrated collective dose to population (person-rem)[c]	1.2	1.1	0.12	0.33	0.06	1.1	1.1	1.7	1.2	2.3×10^{-3}

Table 5.2-19. Estimated public and occupational radiological impacts from atmospheric emissions (continued).

			Separations Alternative			Non-Separations Alternative			Minimum INEEL Processing Alternative	
Receptor	No Action Alternative	Continued Current Operations Alternative	Full Separations Option	Planning Basis Option	Transuranic Separations Option	Hot Isostatic Pressed Waste Option	Direct Cement Waste Option	Early Vitrification Option	At INEEL	At Hanford[a]
Estimated number of latent cancer fatalities to population	6.0×10^{-4}	5.5×10^{-4}	6.0×10^{-5}	1.7×10^{-4}	3.2×10^{-5}	5.5×10^{-4}	5.5×10^{-4}	8.5×10^{-4}	6.0×10^{-4}	1.1×10^{-6}

a. Data based on analysis of the Interim Storage Shipping Scenario which has higher impacts than the Just-in-Time Shipping Scenario. See Appendix C.8.
b. Doses are maximum values over any single year during which waste processing occurs; annual doses from waste stored on an interim basis after waste processing is completed would be much less.
c. The annual average project doses were multiplied by the project duration and summed for all projects within a given option to determine the integrated dose and resultant health effects for each option.
d. Location of highest onsite dose is Central Facilities Area.
e. Population dose assumes growth rate of 6 percent per decade between 1990 and 2035.
f. Dose to population within 50 miles of Hanford Site (person-rem per year).

Operations Alternative, Direct Cement Waste Option, and Minimum INEEL Processing Alternative. The highest integrated offsite maximally exposed individual dose of 0.03 millirem occurs under the Early Vitrification Option. The noninvolved worker doses from facility emissions would also be a small fraction of the allowable limit. The Federal occupational dose limit is 5,000 millirem per year, as established in 10 CFR 835.202. The highest predicted onsite worker annual dose of 1.0×10^{-4} millirem and integrated dose of 1.4×10^{-3} millirem would occur from the Minimum INEEL Processing Alternative. No applicable standards exist for collective population doses; however, DOE policy requires that doses resulting from radioactivity in effluents be reduced to levels as low as reasonably achievable. The highest annual collective dose to the population within 50 miles of INTEC of 0.097 person-rem would occur for the Hot Isostatic Pressed Waste Option. The highest total collective population dose of 1.7 person-rem would occur from the Early Vitrification Option and corresponds to less than 8.5×10^{-4} LCF for the entire operations period. The total integrated collective population doses associated with the other options are lower and range from 0.002 to 1.2 person-rem.

Involved Worker Impacts - Table 5.2-20 provides a summary of radiological impacts to involved workers from facility operations. This table provides the number of involved workers, annual average collective dose, total campaign collective worker dose and estimated increased lifetime number of LCFs for each alternative. The highest annual collective worker dose would occur from the Planning Basis Option. The highest collective worker dose, integrated over the entire campaign would occur from the Direct Cement Waste Option. The total collective worker dose is projected to be 1,600 person-rem, which corresponds to 0.64 LCF.

Table 5.2-21 presents annual radiological impacts for interim storage after the year 2035. Impacts are presented in terms of annual average worker dose for radiological workers and the resultant increase in LCFs. There are no toxic air pollutants or criteria pollutant emissions expected with interim storage activities after the year 2035. The Transuranic Separations Option is not listed in this table because there would be no interim storage of final waste forms produced under this option.

Nonradiological Air Emissions - Table 5.2-22 presents hazard quotients for concentrations of noncarcinogenic toxic air pollutants at the INEEL site boundary for the option with the maximum value. The locations of these modeled concentrations are dependent on different points and times of release, so no single individual could be exposed to all of these chemicals at once. Therefore, these chemical hazard quotients are evaluated separately and not summed. For the individual noncarcinogens, the maximum concentrations for each of the pollutants occur most frequently from the Planning Basis Option. However, all hazard quotients are much less than 1, indicating no expected adverse health effects.

Table 5.2-23 presents hazard quotients for concentrations of carcinogenic toxic air pollutants at the INEEL site boundary by option. As with noncarcinogens, the locations of these modeled maximum concentrations are dependent on different points and times of release so the risks are not summed. The results of this evaluation indicate that the hazard quotients for each chemical range from 7.6×10^{-7} for hydrazine to 0.14 for nickel. As stated in Section 5.2.6, the highest carcinogenic air pollutant impacts are projected for those options that involve the greatest amount of fossil fuel combustion, most notably the Planning Basis Option. For the Planning Basis Option, nickel concentrations could be as high as 14 percent of the State of Idaho standard at the INEEL boundary. Projected carcinogenic concentrations are based on the conservative assumption that all toxic pollutant sources are operating concurrently, and no credit is taken for reductions by air pollution control equipment. All other carcinogens are expected to be at very low ambient levels with negligible health impacts. As stated in Section 5.2.6, concentrations of all carcinogenic and noncarcinogenic substances at INEEL facility areas are less than 1 percent of occupational exposure limits in all cases. Ambient concentrations of carcinogenic and noncarcinogenic toxic pollutants at other public access locations, such as public roads and Craters of the Moon Wilderness Area are presented in Appendix C.2.5.2.

Table 5.2-20. Estimated radiological impacts to involved workers by alternative during facility operations.

			Separations Alternative			Non-Separations Alternative			Minimum INEEL Processing Alternative	
Receptor	No Action Alternative	Continued Current Operations Alternative	Full Separations Option[a]	Planning Basis Option	Transuranic Separations Option[b]	Hot Isostatic Pressed Waste Option	Direct Cement Waste Option	Early Vitrification Option	At INEEL	At Hanford[c]
Annual average number of involved workers	120	260	220	410	190	330	400	180	240	94
Annual average collective dose (person-rem)[d]	23	49	41	80	35	62	76	34	46	NA[e]
Total campaign collective worker dose (person-rem)[f]	490	760	1.1×10^{3}	1.5×10^{3}	980	1.3×10^{3}	1.6×10^{3}	870	1.1×10^{3}	350
Total number of latent cancer fatalities	0.19	0.30	0.44	0.61	0.39	0.51	0.64	0.35	0.42	0.14

a. Assumes LLW Class A type grout disposal in INEEL disposal facility (P35D and P27).
b. Assumes LLW Class C type grout disposal in INEEL disposal facility (P49D and P27).
c. Data based on analysis of the Interim Storage Shipping scenario which has higher impacts than the Just-in-Time Shipping Scenario. See Appendix C.10.4.11. Annual average number of workers based on table C.10-9 employment levels.
d. Doses are average values over any single year during which waste processing occurs.
e. NA = Not assessed.
f. Total campaign dose is based on the average annual dose for each project that comprises each alternative multiplied by the duration for each project and then summed for each alternative.

Table 5.2-21. Estimated radiological impacts to involved workers from interim storage operations post-2035.

Alternatives[a]	Radiological workers/year	Annual average worker dose (rem)	Annual average collective dose (person-rem)	Estimated annual latent cancer fatalities
No Action Alternative (P1D)	15	0.19	2.85	1.1×10^{-3}
Continued Current Operations Alternative (P4)	0	NA[b]	NA	NA
Full Separations Option (P24)	5	0.19	0.95	3.8×10^{-4}
Planning Basis Option (P24)	5	0.19	0.95	3.8×10^{-4}
Hot Isostatic Pressed Waste Option (P72)	2.5	0.19	0.48	1.9×10^{-4}
Direct Cement Waste Option (P81)	4.5	0.19	0.86	3.4×10^{-4}
Early Vitrification Option (P61)	4.5	0.19	0.86	3.4×10^{-4}
Minimum INEEL Processing Alternative (P24)	5	0.19	0.95	3.8×10^{-4}

a. Project Titles: P1D - No Action; P4- Long-Term Storage of Calcine in Bin Sets; P24 - Vitrified Product Interim Storage; P72 - Interim Storage of Hot Isostatic Pressed Waste; P81 - Unseparated Cementitious HLW Interim Storage; P61 - Vitrified Product Interim Storage; P24 - Interim Storage of Vitrified Waste at INEEL.
b. NA = not applicable.

Table 5.2-22. Projected noncarcinogenic toxic pollutant maximum concentrations at the site boundary for the proposed waste processing alternatives.[a,b]

Pollutant[c]	Maximum concentration option	Concentration ($\mu g/m^3$)[d]	Idaho standard ($\mu g/m^3$)	Hazard quotient
Antimony	Planning Basis Option	6.9×10^{-4}	25	2.8×10^{-5}
Chloride	Planning Basis Option	0.05	150	3.3×10^{-4}
Cobalt	Planning Basis Option	7.9×10^{-4}	2.5	3.2×10^{-4}
Copper	Planning Basis Option	2.3×10^{-4}	10	2.3×10^{-5}
Fluorides (as F)	Early Vitrification Option	7.7×10^{-3}	125	6.2×10^{-5}
Lead	Planning Basis Option	2.0×10^{-4}	1.5	1.3×10^{-4}
Manganese (as Mn)	Planning Basis Option	3.9×10^{-4}	50	7.8×10^{-6}
Mercury	Full Separations/Planning Basis Option	1.6×10^{-5}	5	3.2×10^{-6}
Phosphorus	Planning Basis Option	1.2×10^{-3}	5	2.4×10^{-4}
Vanadium	Planning Basis Option	4.0×10^{-3}	2.5	1.6×10^{-3}

a. Emissions include chemical processing and fossil fuel combustion.
b. Only site boundary conditions are listed, conditions at public access on site roads can be found in Appendix C.2.
c. Pollutants listed are those that account for more than 95 percent of health risk. See Appendix C.2 for details.
d. $\mu g/m^3$ = micrograms per cubic meter.

Table 5.2-23. Projected carcinogenic toxic pollutant maximum concentrations at the site boundary for the proposed waste processing alternatives.[a,b]

Pollutant[c]	Maximum concentration option	Concentration ($\mu g/m^3$)[d]	Idaho standard ($\mu g/m^3$)	Hazard quotient
Arsenic	Planning Basis Option	9.3×10^{-6}	2.3×10^{-4}	0.04
Beryllium	Planning Basis Option	2.0×10^{-7}	4.2×10^{-3}	4.8×10^{-5}
Cadmium compounds	Planning Basis Option	2.8×10^{-6}	5.6×10^{-4}	5.0×10^{-3}
Chromium (hexavalent forms)	Planning Basis Option	1.7×10^{-6}	8.3×10^{-5}	0.02
Dioxins and furans[d]	Hot Isostatic Pressed Waste Option	1.8×10^{-13}	2.2×10^{-8}	8.2×10^{-6}
Formaldehyde	Planning Basis Option	2.3×10^{-4}	0.08	2.9×10^{-3}
Hydrazine	Planning Basis Option/Hot Isostatic Pressed Waste Option	2.6×10^{-10}	3.4×10^{-4}	7.6×10^{-7}
Nickel	Planning Basis Option	5.9×10^{-4}	4.2×10^{-3}	0.14

a. Emissions include chemical processing and fossil fuel combustion.
b. Only site boundary conditions are listed. Conditions at public access on site roads can be found in Appendix C.2.
c. Pollutants listed are those that account for more than 95 percent of health risk. See Appendix C.2 for details.
d. $\mu g/m^3$ = micrograms per cubic meter.

For each alternative, maximum incremental impacts of carcinogenic air pollutants are projected to occur at or just beyond the southern site boundary, while maximum non-carcinogenic air pollutant levels would occur along U.S. Highway 20.

5.2.10.4 Occupational Safety Impacts

Estimated occupational injury rates for waste processing alternatives are presented in Tables 5.2-24 and 5.2-25. The projected rates for injury are based on observed historic rates at INEEL. Table 5.2-25 provides estimates of the number of lost work days and total recordable cases that would occur during a peak employment year and for the entire period during construction for each of the alternatives. The projected injury rates are based on INEEL historic injury rates for construction workers over a 5-year period from 1993 through 1997 multiplied by the employment levels for each alternative. Table 5.2-25 provides similar data for the operations phase for each of the alternatives. The projected injury rates are based on the INEEL historic injury rates for operations from a 15-year period from 1983 through 1997 (Millet 1998). The data for lost work days represents the number of workdays, beyond the day of injury or onset of illness, the employee was away from work or limited to restricted work activity because of an occupational injury or illness. The total recordable cases value includes work-related death, illness, or injury which resulted in loss of consciousness, restriction from work or motion, transfer to another job, or required medical treatment beyond first aid.

As shown in Table 5.2-24, the highest occurrences of lost work days and total recordable cases during a peak construction year are projected to occur for the Full Separations Option and the Planning Basis Option. This is due to the larger number of employees and work hours associated with these options during a peak year. The highest total number of cases of lost work days and total recordable cases would be likely to occur for the Planning Basis Option followed by the Full Separations Option due to the larger number of total worker hours associated with these options.

Table 5.2-24. Estimated worker injury impacts during construction at INEEL by alternative (peak year and total cases).

Receptor	No Action Alternative	Continued Current Operations Alternative	Separations Alternative: Full Separations Option	Separations Alternative: Planning Basis Option	Separations Alternative: Transuranic Separations Option	Non-Separations Alternative: Hot Isostatic Pressed Waste Option	Non-Separations Alternative: Direct Cement Waste Option	Non-Separations Alternative: Early Vitrification Option	Minimum INEEL Processing Alternative: At INEEL	Minimum INEEL Processing Alternative: At Hanford[a]
Number of workers during peak year	21	89	1,200	1,300	920	570	510	540	600	NR[b]
Peak year lost workdays[c]	6.6	28	370	420	290	180	160	70	190	NR
Peak year total recordable cases[d]	0.8	3.4	44	51	35	22	20	20	23	NR
Total lost workdays	34	120	1,700	2,000	1,400	720	680	740	840	NR
Total recordable cases	4	14	200	240	170	86	81	88	100	227

a. Data based on analysis of the Interim Storage Scenario. See Appendix C.8.4.11, Table C.8-17.
b. NR = Not reported.
c. The number of workdays, beyond the day of injury or onset of illness, the employee was away from work or limited to restricted work activity because of an occupational injury or illness.
d. A recordable case includes work-related death, illness, or injury which resulted in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid.

Table 5.2-25. Estimated worker injury impacts at INEEL by alternative during operations (peak year and total cases).

Receptor	No Action Alternative	Continued Current Operations Alternative	Separations Alternative: Full Separations Option	Separations Alternative: Planning Basis Option	Separations Alternative: Transuranic Separations Option	Non-Separations Alternative: Hot Isostatic Pressed Waste Option	Non-Separations Alternative: Direct Cement Waste Option	Non-Separations Alternative: Early Vitrification Option	Minimum INEEL Processing Alternative: At INEEL	Minimum INEEL Processing Alternative: At Hanford[a]
Number of workers during peak year	80	350	450	730	320	530	590	330	320	NR[b]
Peak year lost workdays[c]	18	80	100	170	72	120	130	75	71	NR
Peak year total recordable cases[d]	2.6	11	15	23	10	17	19	71	10	NR
Total lost workdays	310	860	2,500	3,100	1,900	2,000	2,300	1,800	1,700	NR
Total recordable cases	44	120	350	430	270	290	330	260	240	27

a. Data based on analysis of the Interim Storage Scenario. See Appendix C.8.4.11, Table C.8-17.
b. NR = Not reported.
c. The number of workdays, beyond the day of injury or onset of illness, the employee was away from work or limited to restricted work activity because of an occupational injury or illness.
d. A recordable case includes work-related death, illness, or injury which resulted in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid.

As shown in Table 5.2-25, the highest occurrences of lost work days and total recordable cases during a peak operations year are projected to occur for the Planning Basis Option followed by the Direct Cement Waste Option. This is due to the larger number of employees and work hours associated with these options during a peak year. The highest total number of cases of lost work days and total recordable cases would also be likely to occur for the Planning Basis Option followed by the Full Separations Option due to the larger number of total worker hours associated with these options.

Table 5.2-26 presents the occurrences of lost work days and total recordable cases for interim storage activities after the year 2035. Impacts are highest for the Direct Cement Option due to the larger number of employees during interim storage operations.

5.2.11 ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, directs each Federal agency to "make…achieving environmental justice part of its mission" and to identify and address "…disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations." The Presidential Memorandum that accompanied Executive Order 12898 emphasized the importance of using existing laws, including the National Environmental Policy Act, to identify and address environmental justice concerns, "including human health, economic, and social effects, of Federal actions."

The Council on Environmental Quality, which oversees the Federal government's compliance with Executive Order 12898 and the National Environmental Policy Act, subsequently developed guidelines to assist Federal agencies in incorporating the goals of Executive Order 12898 in the NEPA process. This guidance, published in 1997, was intended to "…assist Federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed."

As part of this process, DOE identified (in Section 4.12) minority and low-income populations within a 50-mile radius of INTEC, which was defined as the region of influence for the environmental justice analysis. The section that follows discusses whether implementing the proposed waste processing alternatives described in Chapter 3 would result in disproportionately high or adverse impacts to minority and low-income populations. Section C.8.4.19 discusses the environmental justice analysis at the Hanford Site under the Minimum INEEL Processing Alternative.

5.2.11.1 Methodology

The Council on Environmental Quality guidance (CEQ 1997) does not provide a standard approach or formula for identifying and addressing environmental justice issues. Instead, it offers Federal agencies general principles for conducting an environmental justice analysis under NEPA:

- Federal agencies should consider the population structure in the region of influence to determine whether minority populations, low-income populations, or Indian tribes are present, and if so, whether there may be disproportionately high and adverse human health or environmental effects on any of these groups.

- Federal agencies should consider relevant public health and industry data concerning the potential for multiple or cumulative exposure to human health or environmental hazards in the affected population and historical patterns of exposure to environmental hazards, to the extent such information is available.

- Federal agencies should recognize the interrelated cultural, social, occupational, historical, or economic factors that may amplify the effects of the proposed agency action. These would include the physical sensitivity of the community or population to particular impacts.

Table 5.2-26. Estimated annual worker injury impacts to involved workers from interim storage operations post-2035.

Alternative	Workers per year	Lost workdays per year	Total recordable cases per year
No Action Alternative	0	NA[a]	NA
Continued Current Operations Alternative	3	0.7	0.1
Full Separations Option	6.5	1.5	0.2
Planning Basis Option	6.5	1.5	0.2
Hot Isostatic Pressed Waste Option	13	3.0	0.3
Direct Cement Waste Option	17.5	4.0	0.6
Early Vitrification Option	6.5	1.5	0.2
Minimum INEEL Processing Alternative	6.5	1.5	0.2

a. NA = Not applicable.

- Federal agencies should develop effective public participation strategies that seek to overcome linguistic, cultural, institutional, and geographic barriers to meaningful participation, and should incorporate active outreach to affected groups.

- Federal agencies should assure meaningful community representation in the process, recognizing that diverse constituencies may be present.

- Federal agencies should seek tribal representation in the process in a manner that is consistent with the government-to-government relationship between the United States and tribal governments, the Federal government's trust responsibility to Federally-recognized tribes, and any treaty rights.

The environmental justice analysis was based on the assessment of potential impacts associated with the various waste processing alternatives to determine if there were high and adverse human health or environmental impacts. In this assessment, DOE reviewed potential impacts arising under the major disciplines and resource areas including socioeconomics, cultural resources, air resources, water resources, ecological resources, health and safety, and waste and materials during both the construction and operations work phases. Regarding health effects, both normal facility operations and postulated accident conditions were analyzed, with accident scenarios evaluated in terms of risk to the public. Likewise, the analysis of transportation impacts included both normal and potential accident conditions for the transportation of materials.

Although no high and adverse impacts were predicted for the activities analyzed in this EIS, DOE nevertheless considered whether there were any means for minority or low-income populations to be disproportionately affected. The basis for making this determination would be a comparison of areas predicted to experience human health or environmental impacts with areas in the region of influence known to contain high percentages of minority or low-income populations as reported by the U.S. Bureau of the Census.

Environmental justice guidance developed by the Council on Environmental Quality defines members of a "minority" as individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (CEQ 1997). The Council defines these groups as minority populations when either the minority population of the affected area exceeds 50 percent or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis.

Low-income populations are identified using statistical poverty thresholds from the Bureau of Census Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, a community may be considered either as a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Any disproportionately high and adverse human health or environmental effects on minority or low-income populations that could result from the waste processing alternatives are assessed for a 50-mile area surrounding INTEC, as discussed in Section 4.12.

5.2.11.2 Construction Impacts

For environmental justice concerns to be implicated, high and adverse human health or environmental impacts must disproportionately affect minority populations or low-income populations. As shown in Section 5.2.2, Socioeconomics, construction under all the waste processing alternatives would generate temporary increases in employment and earnings in the region of interest.

None of the alternatives is expected to significantly affect land use (see Section 5.2.1), cultural resources (see Section 5.2.3), or ecological resources (see Section 5.2.8) because no previously-undisturbed onsite land would be required and no offsite lands are affected. Sections 5.2.6, Air Resources, and 5.2.10, Health and Safety, discuss potential impacts of construction on human health (both workers and the offsite population) and the environment.

Because construction impacts would not significantly impact the surrounding population, and no means were identified for minority or low-income populations to be disproportionately affected, no disproportionately high and adverse impacts would be expected for minority or low-income populations.

5.2.11.3 Operational Impacts

For environmental justice concerns to be implicated, high and adverse human health or environmental impacts must disproportionately affect minority populations or low-income populations. As shown in Section 5.2.2, Socioeconomics, waste processing operations under all alternatives would either maintain (No Action) or increase employment and earnings in the region of influence. None of the alternatives would result in significantly adverse land use or cultural resources impacts.

Sections 5.2.6, Air Resources, 5.2.8, Ecological Resources, and 5.2.10, Health and Safety, discuss potential impacts of operational releases on human health (both workers and the offsite population) and the environment. As shown in these environmental consequences sections, none of the alternatives would result in significantly adverse impacts.

Impacts from high-consequence, low-probability accident scenarios (Section 5.2.14) would be significant should they occur; however, the impacts to specific population locations would be subject to meteorological conditions at the time of the accident. Whether or not such impacts would have disproportionately high and adverse effects with respect to any particular segment of the population would be subject to natural forces, including random meteorological factors. However, the probability of one of these accidents occurring is extremely low (see Section 5.2.14).

Because the impacts from routine facility operations (see Sections 5.2.6 and 5.2.7) and reasonably-foreseeable accidents (see Section 5.2.14) would be low for the surrounding population and no means were identified for minority or low-income populations to be disproportionately affected, no disproportionately high and adverse impacts would be expected for minority or low-income populations.

Unlike fixed-facility accidents, it is impossible to predict where a transportation accident may occur and, accordingly, who might be affected.

In addition to the variability of meteorological conditions, the random nature of accidents with respect to location and timing make it impossible to predict who could be affected by a severe accident. Although adverse impacts could occur in the unlikely event of a high-consequence transportation accident, any potential disproportionate impacts to these populations would be subject to the randomness of these factors. Routine transportation would be carried out over existing roads and highways. The impacts would be expected to be low on the population as a whole. Because the impacts of routine transportation would be expected to be the same on minority or low-income populations as on populations as a whole, no disproportionately high and adverse impacts on minority or low-income populations would be expected from transportation activities.

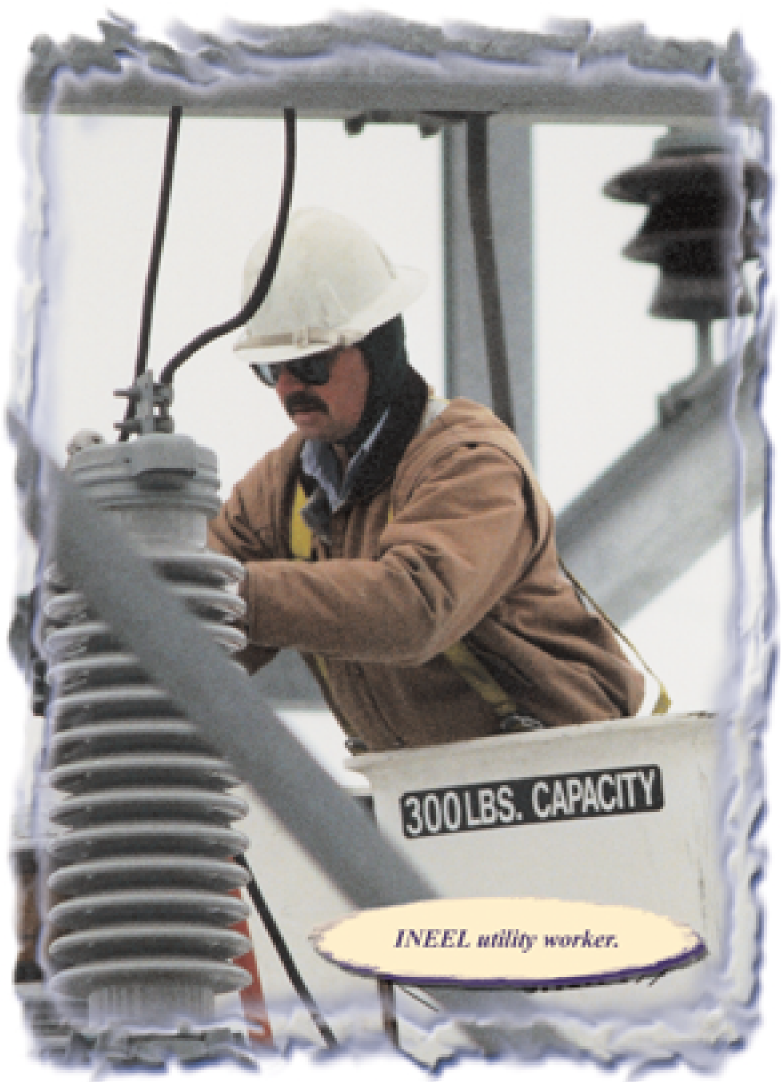
As noted in Section 5.2.10, public health impacts from waste processing activities are based on projected airborne releases of radioactive and nonradioactive contaminants. Because prevailing winds are out of the southwest and northeast (see Section 4.7.1), contaminants released to the atmosphere from INTEC tend to be carried to the northeast (into the interior of INEEL) or southwest (into the sparsely-populated area south and west of INEEL). Minority populations tend to be concentrated south and east of INTEC, in urban areas like Pocatello and Idaho Falls and along the Interstate 15 corridor (see Figure 4-22). The Fort Hall Indian Reservation is also some 40 miles southeast of INTEC (see Figure 4-23). This suggests that minority and low-income populations would not experience higher exposure rates than the general population and that disproportionately high and adverse human health effects would not be expected to occur as a result of HLW processing activities. Releases to surface water would be small by comparison, and would not be expected to result in adverse health impacts.

5.2.11.4 Subsistence Consumption of Fish, Wildlife, and Game

Section 4-4 of Executive Order 12898 directs Federal agencies "whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence and that Federal governments communicate to the public the risks of these consumption patterns." There is no evidence to suggest that minority or low-income populations in the region of influence are dependent on subsistence fishing, hunting, or gathering on the INEEL. DOE nevertheless considered whether there were any means for minority or low-income populations to be disproportionately affected by examining levels of contaminants in crops, livestock, and game animals on the INEEL and from adjacent lands.

Controlled hunting is permitted on INEEL land but is restricted to a very small portion of the northern half of the INEEL. The hunts are intended to assist the Idaho Department of Fish and Game in reducing crop damage on private agricultural lands adjacent to the INEEL. In addition to the limited hunting on the INEEL, several game species and birds live on and migrate through the INEEL. DOE routinely samples game species residing on the INEEL, sheep that have grazed on the INEEL, locally grown foodstuffs and milk around the INEEL for radionuclides (ESRF 1996). Concentrations of radionuclides in the samples have been small and are seldom higher than concentrations observed at control locations distant from the INEEL. The principal source of non-natural radionuclides at these control locations is very small amounts of residual atmospheric fallout from past nuclear weapons tests. Data from programs monitoring these sources of food are reported annually in the *INEEL Site Environmental Report* (ESRF 1996).

Based on DOE monitoring results (ESRF 1996), concentrations of contaminants in crops, livestock, and game animals in areas surrounding the INEEL are low, seldom above background levels. Moreover, the impact analyses conducted for this EIS (see Section 5.2.8) indicate that native plants and wildlife in the region of influence would not be harmed by any of the actions being proposed. Consequently, no disproportionately high and adverse human health impacts would be expected in minority or low-income populations in the region as a result of subsistence consumption of fish, wildlife, native plants, or crops.



INEEL utility worker.

5.2.12 UTILITIES AND ENERGY

This section presents the potential impacts on the projected demand for electricity, process and potable water, fossil fuels, and wastewater treatment from implementing the proposed waste processing alternatives. The analysis includes potential impacts associated with increased demand and usage during construction and operation. The data represent the bounding (or highest potential impact) case for each alternative or option; the data have been totaled for all projects supporting the option and do not take into account the fact that all facilities may not be operating simultaneously. Because one of the alternatives (Minimum INEEL Processing) involves shipment of mixed HLW to the Hanford Site for treatment, possible changes in utility and energy use at Hanford were also evaluated (see Appendix C.8).

5.2.12.1 Construction Impacts

There would be a small amount of construction under the No Action Alternative. It would be necessary to build a Calcine Retrieval and Transport System to retrieve calcine from bin set 1 and transport it to another existing bin set. Implementation of the Continued Current Operations, Separations, Non-Separations, and Minimum INEEL Processing Alternatives would require DOE to construct new waste management and support facilities as described in Chapter 3. New facilities (additional Canister Storage Buildings and a Calcine Dissolution Facility) would be built within the 200-East Area at the Hanford Site under the Minimum INEEL Processing Alternative (Interim Storage Scenario). Appendix C.8 examines the impacts to utility and energy usage for the Hanford Site.

Construction activities would result in increased power and water consumption and wastewater generation. Water usage would include potable water for workers and process water for dust control and other construction-related activities. Domestic and process water would be supplied from existing wells. The use of heavy equipment (e.g., bulldozers, earth movers, dump trucks, compactors) and portable generators during construction would result in the consumption of fossil (diesel) fuel. Table 5.2-27 presents projected utility and energy usage for each alternative. The existing INTEC capacity would adequately support any of the alternatives.

As discussed in Section 3.1.5 under the Minimum INEEL Processing Alternative, DOE would retrieve and transport calcine to a packaging facility, where it would be placed into shipping containers. The containers would then be

Table 5.2-27. Utility and energy requirements for construction by waste processing alternative.[a]

Waste Processing Alternative	Annual electricity usage (megawatt-hours per year)	Annual fossil fuel use (million gallons per year)	Annual potable water use (million gallons per year)	Annual non-potable water use (million gallons per year)	Annual sanitary wastewater discharges (million gallons per year)
INTEC Baseline (1996 usage)	8.8×10^{4}	0.98	55	400	55
No Action Alternative	180	6.6×10^{-3}	0.12	0.041	0.12
Continued Current Operations Alternative	3.4×10^{3}	0.036	0.77	0.11	0.77
Separations Alternative					
Full Separations Option	3.3×10^{3}	0.43	6.6	0.38	6.6
Planning Basis Option	6.5×10^{3}	0.41	6.8	0.41	6.8
Transuranic Separations Option	2.9×10^{3}	0.45	4.7	0.27	4.7
Non-Separations Alternative					
Hot Isostatic Pressed Waste Option	4.0×10^{3}	0.35	3.0	0.28	3.0
Direct Cement Waste Option	4.0×10^{3}	0.39	3.2	0.46	3.2
Early Vitrification Option	900	0.30	2.5	0.30	2.5
Minimum INEEL Processing Alternative					
At INEEL	1.1×10^{3}	0.23	2.9	0.29	2.9
At Hanford Site[b]	2.9×10^{3}	0.092	1.8	0.040	1.8

a. INTEC baseline data from LMITCO (1998); remainder of data from the project data sheets identified in Appendix C.6. Values represent incremental increases from the baseline quantities.

b. Data from Project Data Sheets contained in Appendix C.8.

shipped to DOE's Hanford Site where the HLW would be separated into mixed high- and low-level waste fractions. Each fraction would be vitrified. The vitrified high- and low-level waste fractions would be returned to INEEL. There are two scenarios for shipping INEEL's calcine to the Hanford Site, the Interim Storage Shipping Scenario and the Just-in-Time Shipping Scenario. The data in Table 5.2-27 for the Minimum INEEL Processing Alternative (at INEEL) includes the construction impacts to resources from the Interim Storage Shipping Scenario which is considered the base case in this EIS.

5.2.12.2 Operational Impacts

DOE analyzed the utility and energy requirements for operation of the facilities, projects, and components associated with each of the nine options under the five alternatives discussed in the EIS for the period 2000 through 2035. DOE evaluated the impacts associated with each option relative to existing or historic INEEL capacity and usage.

Operation of INEEL waste processing facilities under any alternative would result in water usage and wastewater generation. Water usage would include potable water for workers and process water for operation of facilities. Domestic and process water would be supplied from existing INTEC wells. Wastewater would be treated at new or existing INEEL facilities. The existing percolation ponds (or their replacements) are capable of handling the service wastewater for all waste processing alternatives.

The existing percolation ponds will be replaced on a like-for-like basis and will be placed approximately 10,200 feet from the southwest corner of INTEC. The environmental impacts for the replacement percolation ponds are discussed in the Waste Area Group 3 CERCLA Record of Decision (DOE/ID-10660). Following the selection of the preferred alternative for HLW waste processing, the requirements for the service wastewater system would be determined. Depending on system requirements, service wastewater system alternatives would be analyzed and a determination to provide supplemental NEPA documentation would be made.

The use of steam generators and backup electrical power generators during operations would consume diesel fuel. Table 5.2-28 presents the operational utility and energy requirements for each alternative or option. The existing INTEC infrastructure would be adequate to support these demands. Utility and energy requirements for operation of facilities at the Hanford Site under the Minimum INEEL Processing Alternative are discussed in Appendix C.8.

There are three methods for disposal of the grouted low-level waste fraction under the Separations Alternative. These methods include (1) disposal in an onsite INEEL disposal facility; (2) disposal in an offsite disposal facility; and (3) disposal in two INEEL facilities, the Tank Farm and the bin sets, after they are closed. The data presented in Table 5.2-28 for the Full Separations and Transuranic Separations Options are for disposal of grout in an onsite INEEL disposal facility, which is considered the base case for this EIS. Resource consumption under other disposal methods is similar (for most resources) to the onsite disposal method.

The waste processing alternatives include projects that would provide interim HLW storage, packaging, and loading. The No Action and Continued Current Operations Alternatives would be similar due to continuing waste generation as a result of long-term storage and monitoring of the calcine in the bin sets. Depending on the alternative, the duration of these activities is shown extending beyond the year 2035. Annual utility and energy requirements during this interim storage period is shown in Table 5.2-29.

Table 5.2-28. Utility and energy requirements for operations by waste processing alternative.[a]

Waste Processing Alternative	Annual electricity usage (megawatt-hours per year)	Annual fossil fuel use (million gallons per year)	Annual potable water use (million gallons per year)	Annual non-potable water use (million gallons per year)	Annual sanitary wastewater discharges (million gallons per year)
INTEC Baseline (1996 usage)	8.8×10^4	0.10	55	400	55
No Action Alternative	1.2×10^4	0.64	1.4	14	1.4
Continued Current Operations Alternative	1.8×10^4	1.9	2.7	62	2.7
Separations Alternative					
Full Separations Option	4.0×10^4	4.5	4.0	5.0	4.0
Planning Basis Option	5.0×10^4	6.3	5.8	69	5.8
Transuranic Separations Option	2.9×10^4	2.2	2.8	53	2.8
Non-Separations Alternative					
Hot Isostatic Pressed Waste Option	3.3×10^4	2.8	3.8	89	3.8
Direct Cement Waste Option	2.8×10^4	2.5	4.8	62	4.8
Early Vitrification Option	3.9×10^4	1.1	2.9	6.3	2.9
Minimum INEEL Processing Alternative					
At INEEL	2.5×10^4	0.49	2.8	6.3	2.8
At Hanford Site[b]	6.6×10^5	1.3	4.8	500	4.8

a. INTEC baseline data from LMITCO (1998); remainder of data from the project data sheets identified in Appendix C.6 (Project Summaries). Values represent incremental increases from the baseline quantities.

b. Data from Project Data Sheets contained in Appendix C.8.

Table 5.2-29. Annual utility and energy requirements from interim storage operations after the year 2035.

Waste Processing Alternative	Annual electricity usage (megawatt-hours per year)	Annual fossil fuel use (million gallons per year)	Annual potable water usage (million gallons per year)	Annual non-potable water usage (million gallons per year)	Annual sanitary wastewater discharges (million gallons per year)
No Action Alternative	4.3×10^3	0.48	0.70	14	0.70
Continued Current Operations Alternative	10	None	0.027	None	0.027
Separations Alternative					
Full Separations Option	290	None	0.059	None	0.059
Planning Basis Option	290	None	0.059	None	0.059
Transuranic Separations Option	None	None	None	None	None
Non-Separations Alternative					
Hot Isostatic Pressed Waste Option	4.4×10^3	None	0.059	None	0.059
Direct Cement Waste Option	4.6×10^3	None	0.059	None	0.059
Early Vitrification Option	4.4×10^3	None	0.059	None	0.059
Minimum INEEL Processing Alternative	290	None	0.059	None	0.059